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Citation: Sumberg, J., D. Keeney and B. Dempsey. (2012). Public agronomy: Norman Borlaug as 'brand hero' for the Green Revolution. *Journal of Development Studies* 48(11): 1587-1600.

Official URL: <http://www.tandfonline.com/doi/full/10.1080/00220388.2012.713470>

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Version: Submitted version (Author's Original Manuscript)

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<http://www.tandfonline.com/doi/full/10.1080/00220388.2012.713470>

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Public agronomy: Norman Borlaug as ‘brand hero’ for the Green Revolution

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Pre-print version. Published as: Sumberg, J., D. Keeney and B. Dempsey. (2012).

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ABSTRACT

This paper examines the role played by Norman Borlaug in promoting the notion of Green Revolution as a way to rapidly transform agriculture in the developing world. It develops the argument that Borlaug used his profile as a ‘public agronomist’, gained through his successful breeding of semi-dwarf wheat varieties, to actively and instrumentally bolster the case for Green Revolution style agricultural development. In effect he played and continues to play the role of a ‘brand hero’ for the Green Revolution.

INTRODUCTION

Agronomy is the application of the plant and soil sciences to crop production. For the most part both applied and research-oriented agronomists labour outside the public gaze despite the fact their work underpins the vital relationship between people and food, and their proximity to important contemporary and highly contested debates around climate change, food security, food prices, food safety, biofuels and land grabs.

A list of modern agronomists who have gained even a modicum of recognition beyond the agricultural research and farming communities would be short, and would include the likes of René Dumont and M. S. Swaminathan. But perhaps the best example of a modern agronomist who operated within the public sphere is Norman Borlaug, wheat breeder, ‘hunger fighter’, ‘father of the Green Revolution’, Nobel Peace Prize laureate and tireless campaigner for the transformation of agriculture in the developing world.

This paper is about the development of Norman Borlaug as a ‘public agronomist’ and how he subsequently used his public profile to promote a particular vision of agricultural development. The argument we develop is that Borlaug’s public profile and credibility were (and continues to be, even after his death) actively and instrumentally used to bolster the case for Green Revolution. In effect, he played and continues to play the role of a ‘brand hero’ for the Green Revolution approach. In making this argument we draw on ideas from two areas of scholarship. The first

focuses on the role, use and power of framing and narrative in policy processes, while the second is concerned with the creation, management and marketing of brands, and particularly the roles of celebrity endorsement and brand heroes in these processes.

It is not our purpose to (1) rehearse the now well known arguments around the various benefits and cost associated with the Green Revolution of the 1960s and 1970s; denigrate or diminish – explicitly or implicitly – the pivotal role that Borlaug played in it; or engage directly with on-going debates around the benefits or otherwise of transgenic crops to smallholder farmers. Rather our purpose is to shed new light on the dynamics of Borlaug’s transition from wheat breeder to public agronomist, and the ways he then used this new role to actively promote a particular model of agricultural development.

We use the term Green Revolution to refer to an approach to agricultural development that sought and continues to seek to rapidly maximise land productivity through the use of modern agricultural technology including genetically superior crop varieties, fertiliser and pesticide. In addition to technology and associated inputs, the success of the Green Revolution approach was and continues to be dependent on the availability of credit, infrastructure and a supportive policy environment. The experience with wheat and rice in countries including Mexico, India, Pakistan and the Philippines from the mid-1950s through the 1970s defined both the potential and the challenges associated with the Green Revolution. Gaud (1968) is usually cited as the originator of the term. In this paper we distinguish between the Green Revolution approach and some other alternative approaches to agricultural development primarily by the importance that the alternatives attach to a ‘sustainability rider’ on the yield maximisation objective.

The remainder of this paper is organised in four parts. In the next section we present a conceptual framework that draws on ideas around framing, narratives, brand community, celebrity endorsement and brand heroes. Following this we trace Norman Borlaug’s development as a public agronomist through the success of his wheat breeding activities and the spread of the resulting varieties from Mexico into Asia. Here we also analyse his involvement in the Sasakawa Global 2000 initiative to ‘bring the Green Revolution to Africa’. In the section that follows we develop the argument that during the last 30 years of his life Borlaug essentially functioned as a brand hero

for the idea of Green Revolution. In the last section we discuss the implications of this analysis.

FRAMING, NARRATIVE, BRANDS AND HEROES

Policy advocates use a variety of different strategies and tactics in order to reinforce or change attitudes to problems or particular policy options held by policy makers, other policy advocates, opinion formers or members of the general public. One of these ‘weapon[s] of advocacy and consensus’ (Weiss 1989, p.117) is framing, ‘the process of selecting, emphasizing, and organizing aspects of complex issues, according to overriding evaluative or analytical criterion’ (Daviter 2007, p.654). Another is narrative (Keeley & Scoones 2003, Roe 1991).

The basic observation that underpins the interest in framing is that in some situations small changes ‘in the presentation of an issue or an event produce (sometimes large) changes of opinion’ (Chong & Druckman 2007, p.104). This is referred to as the ‘framing effect’. While much of the research literature focuses on the effects of framing by elites (e.g. politicians) on public opinion, the same dynamic plays-out among elites, within policy communities and so on. Chong and Druckman (2007, p.111) suggest that framing can work at three levels: ‘making new beliefs available about an issue, making certain available beliefs accessible, or making beliefs applicable or “strong” in people’s evaluations’. Framing is best conceptualised as a process that evolves over time (Chong & Druckman 2007). It is a political act which, if successful, carries with it the ability ‘to influence ensuing policy dynamics over the long run to the extent that the specific representation and delineation of policy issues shapes the formation of substantive interests and at times restructures constituencies’ (Daviter 2007, p.655). In other words, rather than being an antecedent of action, framing is ‘at the heart of the action itself’ (Weiss 1989, p.98).

The role of narratives in development policy, and in policy processes more generally, is now widely recognised (Roe 1991). A policy narrative is a story that provides a simple and accessible explanation of a complex situation. As such, a narrative highlights a specific problem and then identifies its cause and a preferred policy response. Policy narratives use stylised facts in an effort to galvanise and engender action: they are not encumbered by theory, details, caveats, uncertainty or

the often inconvenient truths of site and context specificity. Some narratives are surprisingly resilient and long-lived despite the undermining of their key elements by empirical research and bitter experience, and the emergence of equally plausible counter narratives. Framing and narrative work hand-in-hand to cut through the disorder and complexity of the real world. Policy advocates use competing narratives, framed in particular ways, to push policy processes toward their favoured responses and outcomes.

The literature on framing and narrative within policy processes is not often brought together with the extensive literature on brands and brand management that is associated with business studies, marketing and cultural studies. Nevertheless we suggest there are strong links between the dynamics of framing and narratives in policy processes and those of branding and marketing. A brand is a device that is used to differentiate one product, service, organisation or idea from another. According to Kay (2006) 'the function of a brand is to create meaning' which is done through a name and the use of selected symbols, slogans and associations. In creating, building and managing a successful brand these elements coalesce into a narrative or story that prompts action and loyalty (i.e. continued action) amongst a target group.

Given its economic importance and financial implications it is not surprising that the literature around branding is both rich and plentiful (Keller & Lehmann 2006). Here, with our focus on the Green Revolution and Norman Borlaug, we highlight only the notions of brand community, celebrity endorsement and brand hero. The basic argument is that we can understand the continued promotion of the Green Revolution in response to food insecurity and rural poverty ('hunger'), as an exercise in creating and building a brand. Differentiation is fundamental to the notion of brand. So, if 'agricultural development' is a generic or undifferentiated product, then Green Revolution represents a specific type of or approach to agricultural development. As such it is differentiated from both the generic form and from other approaches such as organic farming, low-external input agriculture, sustainable agriculture, agro-ecology, food sovereignty or 'sustainable intensification' (some of which developed in response to and all of which are promoted as alternatives to Green Revolution). This differentiation works first and foremost through the world-wide recognition of the name Green Revolution. Like all successful brands the Green Revolution has spawned imitators including the White Revolution, referring to small-scale milk production in

India (Bellur *et al.* 1990, Parthasarathy 1991); the Blue Revolution, referring to aquaculture (Coull 1993); the Maize Revolution, referring to small-holder maize production in Africa (Byerlee & Eicher 1997); the Evergreen Revolution, referring to the idea that it is possible to use technology to increase productivity in perpetuity without ecological harm (Swaminathan 2004); and the Doubly Green Revolution, referring to the necessity of integrating environmental conservation with agricultural productivity enhancement (Conway 1999).

The meaning that is associated with the Green Revolution brand is fundamentally about the need to rapidly increase crop productivity in order to feed hungry people. Looked at another way, the Green Revolution brand is framed by the poverty, hunger and famine that characterised the post-war period in Asia and some other parts of the developing world. It relies on a simple narrative to ‘create meaning’ and prompt action. This narrative suggests that as was so dramatically demonstrated for wheat and rice during the period 1944 – 1970, modern agricultural technology (principally high yielding varieties combined with appropriate management, fertiliser, pesticides, irrigation, credit and reasonable farm-gate prices), developed through focused scientific research, can significantly increase the productivity of staple crops on small farms in the developing world. Modern agricultural technology to maximise crop yield is thus the essential weapon in the battle against food insecurity, hunger and starvation (and the likelihood of social unrest).

In addition to the brand name, a number of other associations and images help to power this narrative. These include the references to famine, starvation and the Malthusian dilemma, which reinforce the impression that the problem is both severe and urgent. The use of military references – including weapons, fight, struggle and battle – provides a sharp moral or crusading edge to ‘humanitarian’ interventions. The military imagery also opens a place for key individuals whose leadership, vision and dedication can drive the troops forward into battle.

We argue that conceiving of the Green Revolution as a brand, supported by an internationally recognised name and a compelling narrative, is justified because as with any brand, the objective is to increase awareness and build or strengthen support for specific actions. While with consumer brands (e.g. Coke, Nike and Apple) the action of interest is primarily the purchase of the branded product, in the case of the Green Revolution the desired actions are increased support for yield maximising

agricultural research and commitment to the resulting set of crop production technologies. Here ‘brand loyalty’ translates into consistent, long-term support for the Green Revolution approach to agricultural development.

In making this argument we draw on the concept of brand community, which Muniz and O’Guinn (2001, p.412) define as ‘a specialised, non-geographically bound community, based on a structured set of social relations among admirers of a brand’ (also see McAlexander *et al.* 2002). The central idea here is that there is much more than a simple, isolated, one-way relationship between a brand and a consumer. Rather, members of a brand community are actively involved in the brand’s construction and promotion. In effect, depending on the nature of the product, brand and so on, brands are co-constructed and co-promoted through the brand community. For the Green Revolution brand of agricultural development the contemporary brand community might be considered to include bi-lateral funders (USAID, DFID, JICA...), national and international agricultural research organisations and initiatives, The Alliance for a Green Revolution in Africa (AGRA), the Ford, Rockefeller and Gates Foundations, companies supplying agricultural inputs (including seeds, fertiliser, pesticides and machinery) and agricultural policy makers at all levels.

The value of celebrity endorsement in brand creation and management has long been recognised (McCracken 1989). The association of a celebrity with a brand helps to create the meaning that makes the brand a compelling proposition. The attractiveness and credibility of the endorser are two characteristics that have been central to research on celebrity endorsement. However, McCracken (1989, p.301) suggests that this approach is not sufficient for analysing the dynamics of celebrity endorsement because endorsement is a cultural process that ‘consists in the transfer of these meanings from the celebrity to the product, and from the product to the consumer’. Celebrity endorsement is central not only to the marketing of consumer brands, but also to the marketing or promotion of more abstract ideas and causes. For example, in the fields of environment and development, Brockington (2008) explores the role of ‘celebrity conservationists’ in promoting what he argues are ‘powerful’ but ‘ungrounded’ environmentalisms; Goodman (2010) analyses how celebrities have been used to embody the mainstreaming of Fairtrade as quality products in the UK; and Goodman and Barnes (2010) look at the roles of celebrities in promoting international development more broadly (also see, Richey & Ponte 2011).

A recent refinement in the literature on celebrity endorsement is the notion of the brand hero. While a celebrity endorsement works because of the associations the target audience makes with the celebrity, brand heroes ‘derive[s] their perceived expertise from their involvement in the creation or production of the brand’ (Eagar 2009). Brand heroes are internally generated celebrities ‘who are recognised by the brand community for their role within the brand’s creation’ (Eagar 2009). In contrast to celebrity endorsers, the credibility of brand heroes comes from their role in establishing or maintaining brand values, and their concern, as a member of the brand community, with the brand's success. So, while a footballer might provide a celebrity endorsement for a particular brand of potato crisps, the relationship of Steve Jobs to the Apple brand is closer to that of a brand hero (i.e. he was intimately involved with the creation of the brand and the maintenance of Apple’s values). In this sense a brand hero can be seen as a further development of Brockington’s ‘celebrity conservationists’ who ‘win fame from their conservation activities’ (Brockington 2009, p.62-63), the distinction being that not all celebrity conservationists are associated with what could be construed as a particular ‘brand’ of conservation. Eagar (2008) highlights the importance of the mythology surrounding brand heroes, a point we return to later.

The argument that we develop in the remainder of the paper is that Norman Borlaug meets the criteria of and functioned as a brand hero. His public recognition (starting with the award of the Nobel Peace prize in 1970) and his recognition by and credibility within the brand community were all tied directly to his success as a breeder of rust-resistant and then high yielding, semi-dwarf wheat. This success was critical for the eventual creation and continuing promotion of the Green Revolution brand.

THE MAKING OF A PUBLIC AGRONOMIST

Borlaug’s life and career are very well documented (Bickel 1974, Hesser 2006, Quinn 2008, Swanson 2009, Vietmeyer 2009a, Vietmeyer 2009b, Vietmeyer 2009c, Vietmeyer 2011) (also see Table 1). In order to explain what are portrayed as his defining traits – single-mindedness and a strong work ethic – these accounts invariably highlight his humble roots in rural Iowa and the formative role of family,

farm life and competitive sports. They are also unanimous in suggesting that his encounter with Depression-era urban poverty as a university student resulted in a life-long commitment to the alleviation of hunger and poverty. Following Eagar these aspects of Borlaug's life might be considered part of a 'creator myth'. The point here is not to question the veracity or importance of these events, but rather to recognise their role, because 'the myth of the brand hero prior to the brand's creation still reflecting the brand's values is important to the brand community' (Eagar 2008).

Table 1. Borlaug timeline.

1914	Born, northern Iowa
1937	Marries Awarded BS degree in forestry, University of Minnesota
1941	Accepts job with E. I. DuPont Nemours & Company
1942	Awarded PhD in plant pathology & genetics, University of Minnesota
1944	Goes to Mexico to work within the Cooperative Wheat Research and Production Program of the Office of Special Studies, a joint government of Mexico and the Rockefeller Foundation
1946	Develops 'shuttle breeding' technique
[1962	Release of first semi-dwarf wheat variety in Mexico]
1966	Named Director of the International Wheat Improvement Programme at the newly formed International Maize and Wheat Improvement Center (CIMMYT)
[1968	Pakistan declared self-sufficient in food production]
1968	Awarded First International Service Award in Agronomy by American Society of Agronomy (ASA)
1970	Awarded Nobel Peace Prize
[1974	India declared self-sufficient in food production]
1977	Awarded President's Medal of Freedom
1978	Member, Presidential Commission on World Hunger
1979	Ends full-time employment with CIMMYT
1984	Joins Texas A&M University as professor
1985	Helps establish Sasakawa-Global 2000; served as President until his death
1986	Played major role in establishment of World Food Prize
1990	Member, Presidential Commission on Science and Technology
1996	World Food Prize Laureate
1999	Named by <i>Time Magazine</i> as 'one of 100 most influential minds of the 20th century'
2000	Awarded Vannevar Bush Award for lifetime achievement in science
2002	Awarded Public Welfare Medal of the National Academy of Sciences
2005	Founds Borlaug Global Rust Initiative (with FAO)
2007	Awarded honorary doctorate from Texas A&M University Awarded Congressional Gold Medal
2009	Died of cancer in Dallas, Texas

NB: The entries in this table are meant to be illustrative as opposed to exhaustive.

We pick up the story in 1944 when, following a PhD in plant pathology at the University of Minnesota and two years of employment at the chemical company DuPont Nemours, Borlaug joined the Office of Special Studies (OSS), a newly established collaborative programme between the Mexican government and the Rockefeller Foundation. This programme, developed following a suggestion from incoming US Secretary of Agriculture (Orville Freeman) to the Rockefeller Foundation, had the objective bringing modern science to bear on Mexico's low productivity agricultural sector and the poverty, chronic hunger and social instability associated with it.

Borlaug's work within the OSS involved the establishment and management of a large-scale wheat breeding programme with an initial focus on resistance to the

disease stem rust (*Puccinia graminis*). The innovative elements of this programme included the very large number of crosses that were made and the use of ‘shuttle breeding’ which resulted in more rapid genetic progress by allowing two selection cycles per year (Borlaug 1953). Shuttle breeding also helped identify genetic material that displayed wide environmental adaptation.

The programme also introduced the dwarfing genes, which Japanese breeders had worked with in the 1930s, into its spring wheat germplasm. Eight years after the initial crosses the first rust resistant semi-dwarf varieties were made available to farmers in Mexico in 1962 (Ortiz *et al.* 2007). The great advantage of the short stature varieties was that they were less likely to lodge (fall over) with the application of nitrogen fertiliser, and were more efficient in converting fertiliser nutrients into additional grain. They thus represented a significant opportunity for productivity enhancement. Shorter wheat and rice varieties combined with fertiliser and good overall agronomy were to become a cornerstone of the early Green Revolution in both Latin America and Asia.

Even before the semi-dwarf ‘Mexican wheats’ really made their mark in India and Pakistan, the OSS experience served as a catalyst for the establishment of the International Rice Research Institute (IRRI) in the Philippines in 1960, which was followed in 1966 by the International Centre for Maize and Wheat Improvement (CIMMYT) in Mexico. These were the first of what was to become a global network of (presently 15) agricultural centres that in 1970 were brought together under the umbrella of the Consultative Group on International Agricultural Research (CGIAR). Borlaug served as the Director of CIMMYT’s International Wheat Improvement Programme from 1966 until 1979, and was a consultant to CIMMYT for many years thereafter.

There can be no questioning the fact that the OSS, Borlaug and eventually CIMMYT were at the epicentre of developments of global significance. The rust-resistant semi-dwarf wheat varieties from the OSS programme were widely used in breeding programmes and relatively quickly, semi-dwarf, broadly adapted and high yielding wheat and rice varieties came to dominate key production areas in Latin America and Asia. Combined with investments in extension, fertiliser and infrastructure development, this shift resulted in dramatic increases in farm-level productivity and aggregate food production. While many different individual

researchers, institutes, government departments and officials were involved in the development and promotion of these varieties and their associated management systems, they were all influenced to a greater or lesser degree by Borlaug and the OSS wheat experience. The training, capacity-building and international outreach activities undertaken by OSS and later CIMMYT were extremely important channels for this influence.

By the time he was awarded the Nobel Peace Prize in 1970 Borlaug was already well known in US and international agriculture circles. The fact of being the first agricultural scientist to be recognised by the Nobel Committee inevitably raised his public profile as did the many honours and awards that followed. He soon grew into the role of a public agronomist and in so doing showed no inclination to shy away from contentious issues. For example, he introduced a 1972 article in *Bioscience* in which he argued against restricting the use of DDT and other pesticides as follows:

The current vicious, hysterical propaganda campaign against the use of agricultural chemicals, being promoted today by fear provoking, irresponsible environmentalists, had its genesis in the best selling ‘half-science-half-fiction novel’ *Silent Spring*, published in 1962. This poignant, powerful, book – written by the talented scientist Rachel Carson - sowed the seeds for the propaganda whirlwind and the press, radio and television circuses that are being sponsored in the name of conservation today, but which are to the detriment of world society, by the various organizations making up the environmentalist movement. (Borlaug 1972a, p.41)

This and other publications along similar lines (Borlaug 1971a, Borlaug 1972b, Borlaug 1974) provoked considerable controversy (Bennett 1972, Hendrix 1972, Krebs 1972, Peakall 1972, Philogen 1972, Robinson 1972), and illustrate Borlaug’s willingness to operate outside the traditional comfort zone of agronomists. Another example of his readiness to publicly promote his deeply held beliefs, even at the cost of controversy, is his oft-repeated suggestion that the enhancement of agricultural productivity on good quality land should be seen as a land and nature conservation strategy in that it reduces the pressure on forest and marginal lands (Borlaug 1972a, Borlaug 2007). This has been called by some the ‘Borlaug Hypothesis’ (Angelsen &

Kaimowitz 2001, Pearce 2011), and opened Borlaug to the charge of being an apologist for industrial agriculture and corporate agri-business interests (Mwale 2006).

Neither Borlaug nor those who so actively lionized him (and continue to do so) would countenance any questioning or critique of the Green Revolution. Those who raised early concerns about the Green Revolution's methods or social, economic or environmental impacts (e.g. Cleaver 1972, and many others, Frankel 1971, Ladejinsky 1970, Paddock 1970), were ignored, brushed-off or (as in the DDT example above) ridiculed. Critics were labeled as 'environmentalists', 'academics', 'bureaucrats' or 'defeatists' who, it was suggested, had never experienced hunger or worked a day in the fields with poor farmers. From Borlaug's perspective there could be no doubt about the fact that everyone gained from higher yields increased food availability. Without judging the merits of the various critiques of the Green Revolution, we might see Borlaug's reaction as a deliberate strategy of closing down discussion of alternative pathways and analyses (Leach *et al.* 2010). It is of course important to remember that policy advocates of all persuasions – including those promoting alternatives to the Green Revolution approach – actively use framing and narratives, and also attempt to close down consideration of the alternatives they do not prefer.

Bringing the Green Revolution to Africa

A significant step in Borlaug's development as a public agronomist was his involvement in a high-profile initiative to 'bring the Green Revolution to Africa'. This episode illustrates not only his growing public profile, but also how the treatment of information about the Green Revolution has been influenced by Borlaug's public image and reputation.

By the mid-1980s Western public awareness of food insecurity in sub-Saharan Africa was high following media coverage of famine in Ethiopia in 1984 (Brinkley 1996). At this point Borlaug was 'settling into the role of senior statesman in the world food community' (Hesser 2006) and was actively engaged in debates far beyond the realm of wheat breeding. In 1984, Borlaug was approached by Japanese billionaire Ryoichi Sasakawa, who offered to fund initiatives to bring the Green

Revolution to Africa (Brinkley 1996, Hesser 2006). Borlaug reluctantly agreed to organise a conference in Geneva on the subject, and subsequently to lead several pilot projects in African countries funded by Sasakawa's Japan Shipbuilding Industry Foundation. Ryoichi Sasakawa then entered into partnership with former US president Jimmy Carter and his organisation Global 2000 (that had the explicit intention of 'transform[ing] sub-Saharan Africa from an agricultural wasteland to a thriving breadbasket' (Brinkley 1996, p.54)). Together, they formed the organisation Sasakawa-Global 2000 (SG2000).

Under Borlaug's technical leadership, SG2000 began 'dynamic field testing and demonstration programmes', promoting new maize and sorghum seed, fertiliser and other technology (Borlaug & Dowsell 1995, Ortiz *et al.* 2007). The first two countries to host trials were Ghana and Sudan, with Ghana being chosen because of its manageable size, climate, abundant minerals and political support. Sudan in contrast was not seen by Borlaug as a good candidate as it suffered from droughts, parasitic diseases and ongoing conflict. Carter however, explicitly pushed for Sudan to be included precisely because the challenges were so great; by working in Sudan he hoped to use 'agricultural diplomacy' to address the country's political challenges (Brinkley 1996).

SG2000 provided credit so farmers could use the new technology on relatively large 'production test plots' (PTPs). Some years later it was reported that 'Virtually without exception, the PTP yields obtained by the participating farmers are two to three times higher – and occasionally four times higher – than the control plots employing traditional methods. Only rarely has the PTP plot yield failed to double that of the control' (Borlaug & Dowsell 1995, p.121). In Ghana, using new cultivars resistant to maize streak virus, SG2000's programme expanded from 40 plots in 1986 to 80,000 in 1989 (Hesser 2006), and national maize production was said to have increased by almost 50% within three years (Ortiz *et al.* 2007). In Sudan, initial plans to work in rain-fed areas were abandoned owing to security concerns, and the project focused instead on irrigated wheat production. By combining a new Indian heat-resistant variety with fertiliser, they demonstrated that significant increases in yield could be obtained. During the first three years of SG2000's operations in Sudan wheat production was reported to have increased from 150,000 tonnes to over 750,000 tonnes (Brinkley 1996, Ortiz *et al.* 2007). A central element of SG2000's projects was

the use of Quality Protein Maize (QPM) cultivars (Quinn 2008). Grain of these cultivars, based on the natural opaque-2 mutant, contain twice as much of the essential amino acids lysine and tryptophan as conventional maize, and it was hoped that they could help to reduce malnutrition in areas with high levels of protein deficiency. In the early 1990s, SG2000 introduced into Ghana a variety of QPM they named *Obatanpa* meaning ‘good nursing mother’ in Ashanti.

The initial results of SG2000’s projects in Ghana and Sudan caused great excitement, and led to the establishment of projects in a further 13 African countries including Ethiopia, Tanzania, Benin, Togo and Nigeria. SG2000’s work brought claims that the Green Revolution was finally coming to Africa (Ortiz *et al.* 2007). Brinkley (1996) hails the results in Ghana as a ‘stunning success’, while Hesser (2006) reports that because of the success of SG2000 Borlaug became a household name and a ‘hero’ in parts of Africa. Despite such acclaim, however, the record of SG2000 is ambiguous. According to Ortiz *et al.* (2007), drought and a lack of infrastructure significantly undermined the SG2000 intensive production model. In some cases, the initial increases in production were followed by a collapse in grain prices, leaving farmers unable to repay their loans and production increases were not sustained once SG2000 had withdrawn its support (Ortiz *et al.* 2007).

The SG2000 experience was interpreted in a variety of ways. Borlaug was encouraged by the fact that African farmers ‘want access to technologies that can reduce the drudgery of agriculture and dramatically improve crop productivity and income’ (Borlaug & Dowswell 1995, p.128) but saw numerous hurdles including a lack of infrastructure, the need for public sector reform and the attitudes of Western environmentalists and ‘some sociologist-anthropologists, economists and other agricultural professionals’ who denied the need for fertiliser and other modern inputs and romanticised traditional farming practices (Borlaug & Dowswell 1995, cf. Farrington 1995). Carter is reported as saying ‘if they can stop killing each other Sudan could once again be the breadbasket of Africa’ (Brinkley, 1996: 62). Limited investment in agriculture and lack of ‘political will’ were invoked to explain the disappointment around SG2000. Despite the failure of SG2000 to instigate an ‘Asian-style’ Green Revolution in Africa, those promoting the idea today draw encouragement from the SG2000 experience and Borlaug’s contribution to it:

Chissano (2010) for example portrays it as vital groundwork for a revolution that is yet to take place.

SG2000 gained a lot from its association with Borlaug and there is little doubt that Borlaug's involvement with SG2000 further enhanced his reputation as a global humanitarian. The back cover of his authorised biography carries a quotation from former US president George H. W. Bush, stating: 'I have been particularly impressed by his work in Africa... Dr Borlaug is an American hero and a world icon' (Hesser, 2006). Along similar lines, Dr Akinwumi Adesina, Vice President of the Alliance for a Green Revolution in Africa (AGRA), hails Borlaug for:

'...sow[ing] the seeds for change here in Africa. He was a great champion of this continent not just through the contributions of his scientific knowledge of agriculture but also through his unwavering belief that Africa could, with the right strategies and focused investment and commitment from governments here and abroad, feed itself' (Adesina 2010).

Borlaug's engagement with SG2000 illustrates further his willingness to move beyond the narrow confines of plant breeding. It also shows that he was beginning to be used by others for the delivery of larger political objectives. Carter's intentions, as illustrated by his choice of Sudan as a trial country, were primarily political – to enhance peace through agricultural production. The association with Borlaug brought another 'heavy hitter' to this cause (Brinkley 1996, p.54).

BORLAUG AS BRAND HERO

The brand hero is the central figure within a brand community. While most of the literature dealing with brand communities relates to consumer brands (McAlexander *et al.* 2002, Muniz & O'Guinn 2001, Stokburger-Sauer 2010), here we focus on the community of individuals and organisations who believe in and promote the Green Revolution approach to agricultural development. This community is not geographically bound, but it is characterised by 'structured social relations' (e.g. between policy makers, funders, researchers and the media), and thus fits the conception of brand community developed by Muniz and O'Guinn (2001). While

none of the members of this community would necessarily consider the Green Revolution as a ‘brand’ or see themselves as part of a brand community, they nevertheless share a deeply-held commitment to the Green Revolution approach to agricultural transformation as a key hunger and poverty reduction strategy in rural areas.

We argue that among the members of this community Borlaug played (and posthumously continues to play) the role of brand hero, i.e. an individual whose credibility derives from his intimate involvement in the creation of the brand and who embodies brand values (Eagar 2009). The hero status of Borlaug is evident in the labels and claims that are commonly associated with him: ‘father of the Green Revolution’ (Tomar 2009); ‘the man who fed the world’ (Hesser 2006); ‘the man who saved more people than anyone else in history’ (McGovern 2010); ‘the man who saved a billion lives’²; and ‘the man who proved Malthus wrong’ (Guillebaud & Hayes 2008, Tuns 2009). His status amongst the members of the Green Revolution brand community is amply demonstrated by the many honorary degrees and other awards he was given and the tone of the numerous obituaries and reminiscences that marked his passing (e.g. Bagla 2009, Iwanaga 2009, Khush 2009, Palagyi 2009, Rajaram 2011, Swaminathan 2009).

During the three decades between his retirement from full time employment at CIMMYT and his death in 2009, Borlaug never stopped promoting the idea of the Green Revolution. We reviewed above his involvement in and guidance of the SG2000 initiative. Beyond this he repeatedly used high impact scientific journals to make the case for Green Revolution, as illustrated by a series of articles published in *Science*. In 1983 he reviewed the contribution of conventional plant breeding in increasing grain productivity, and argued for continued investment in these methods since ‘they represent the major line of defence today on the food front’ (Borlaug 1983, p.693). In a letter to *Science* in 2004 he cited the fact that plant breeding research at CGIAR centres had declined 6.5 per cent per year for a decade as evidence that the CGIAR had ‘lost touch with its original purpose—to feed the hungry’. Here he argued for a renewed focus on the system’s comparative advantage, namely ‘developing improved food crop varieties, using a combination of conventional plant breeding techniques and new techniques of biotechnology, with complementary crop management practices, to address major production issues in both the favored and the

more difficult marginal lands' (Borlaug 2004b). In a 2007 editorial piece in *Science* he again argued for a commitment to research-driven agricultural development by highlighting the productivity gains achieved since the 1950s and then returned to one of his favourite themes, the links between population growth, food production and environmental sustainability (Borlaug 2007).³

If key elements of his vision for the Green Revolution remained constant over this period – including productive crop varieties, increased fertiliser use, investment in research and infrastructure – Borlaug's vision was not static. This is illustrated by his changing attitude toward biotechnology and genetic engineering. In his 1983 review of conventional plant breeding published in *Science* he acknowledged there were 'potentially great payoffs' to genetic engineering but argued that there was as yet 'no firm evidence' that the progress seen in work with bacteria and yeast could be repeated in higher plants. In any case, he argued that there was no basis on which to assume that pest resistance developed through genetic engineering would be more durable than that developed through conventional techniques. In sum, while genetic engineering warranted some investment, conventional plant breeding should remain the mainstay of crop improvement (Borlaug 1983). Over the next twenty years, as the field developed, he became more enthusiastic about biotechnology and transgenic varieties, citing the potential to reduce pesticide application and to identify "'master genes' for high yield potential by eliminating the confounding effects of other genes" (Borlaug 2002). Now he argued for the CGIAR to return to its original focus on crop improvement 'using a combination of conventional plant breeding techniques and new techniques of biotechnology' (Borlaug 2004b). He also warned about the potential spilling over of negative attitudes toward transgenic crops from the developed to the developing countries.

But his attitude was hardening and the tendency to ridicule opposing views is again evident in the forward he contributed to *The Frankenfood Myth: How Protest and Politics Threaten the Biotech Revolution* (Miller & Conko 2004). Here he described the refusal of some southern African countries to accept US food aid composed of transgenic Bt maize as 'an obscene exaggeration of risk' (for an alternative perspective see, Bohannon 2002, Mwale 2006), and the resistance to transgenic crops more generally as 'yet another sordid episode in this larger anti-technology, junk-science movement' (Borlaug 2004a). By 2007, taking into account

both the growing experience with transgenic crops and the projected effects of climate change, he had reservations about the future role of biotechnology: ‘Genetically engineered crops are playing an increasingly important role in world agriculture, enabling scientists to reach across genera for useful genes to enhance tolerance to drought, heat, cold, and waterlogging, all likely consequences of global warming. I believe biotechnology will be essential to meeting future food, feed, fiber, and biofuel demand’ (Borlaug 2007, emphasis added)

Borlaug’s embrace of biotechnology and transgenic crops was associated with an increasingly close relationship with the biotechnology industry. Since 1990 he had been the ‘first founding patron’ of the International Service for the Acquisition of Agri-Biotech Applications (ISAAA), a not-for-profit organisation whose donors include a number of prominent biotechnology, seed and agribusiness corporations. Borlaug’s position on biotechnology encapsulated in the 2007 quote above, allowed ISAAA and others associated with the industry to blur the boundaries between the past gains from the Green Revolution (achieved without biotechnology or transgenics) and their claims regarding the future potential of transgenic varieties to enhance the productivity (and the livelihoods) of small farmers in the developing world (e.g. Anonymous 2009, Beachy 2010, cf. Glover 2010, Herring 2007, Lipton 2007). In other words, taking the lead from Borlaug himself, supporters of biotechnology have appropriated (and continue to appropriate) his status as brand hero in order to bridge the gap between (his) past achievements and (their) future promises, for the purpose of strengthening the case for the acceptability – indeed necessity – of transgenic crops. Scoones (2006) makes a similar argument in the context of India where ‘the rhetoric of moving from a ‘Green Revolution’ to a ‘Gene Revolution’, or the ushering in of a biotech-led ‘Second Green Revolution’ conjures up a strong sense of continuity with the heroic success of the 1960s and 70s’ (p.27-28).

DISCUSSION

We have traced Norman Borlaug’s pathway into the realm of public agronomy through a number of distinct phases: working wheat breeder; promoter of a particular approach to wheat breeding; promoter of the Mexican wheat varieties in Latin

America and subsequently Asia; promoter of the Green Revolution more generally; brand hero of the Green Revolution; and finally, appropriated celebrity.

This evolution was fuelled by a deep personal commitment to ending hunger. He framed this commitment in terms of the spectre of hunger, mass starvation and what he referred to as the ‘Population Monster’ (Borlaug 1971b, Borlaug *et al.* 1969). This framing supported a compelling crisis narrative: for Borlaug, the only way to confront this ‘onrushing (threatening) future’ (de Wilde 2000, Jansen & Gupta 2009) was through focused research and the intensive use of agricultural technology to maximise crop yield. Borlaug’s single-minded dedication to this task necessitated a stripped-down, simplified worldview in which there was no place for any consideration of trade-offs, winners and losers, social and political relations, or the CGIAR’s transgressions into non-core research areas such as natural resource management, participation, gender and systems research. Similarly, alternative analyses and criticism were neither helpful nor welcomed, and Borlaug used his growing recognition within the agriculture, science and policy communities to close down consideration of other views and methods. What could ‘butterfly chasing’ academics, environmentalists or bureaucrats possibly know about the realities of hunger fighting (see Hesser 2006, p.166)? In his view their misplaced concerns only delayed the delivery of desperately needed new technologies to farmers, and thus prolonged the hunger and misery of millions.

Borlaug was without doubt a central actor in the events that enabled the dramatic increases in wheat and rice productivity and production during the 1960s and 1970s. His contributions were widely recognised and celebrated and his name became synonymous with the Green Revolution brand of agricultural development. For nearly four decades he used his professional credibility and enhanced public profile to promote Green Revolution, which he argued was the only viable way to fight hunger effectively. Without Borlaug (or someone playing a similar role), interest in the Green Revolution brand may have been more difficult to sustain, and more space might have opened up for debate about alternative approaches and methods.

One important dynamic which began in earnest with the award of the 1970 Nobel Peace Prize, and continues today, is rooted in the way that Borlaug’s life and career are portrayed. The biographies (Bickel 1974, Hesser 2006, Swanson 2009, Vietmeyer 2009a, Vietmeyer 2009b, Vietmeyer 2009c) and hundreds of obituaries

tend toward hero worship: by-and-large they offer little in the way of analysis or insight. This is particularly disappointing in relation to Borlaug's involvement in the SG2000 initiative where the lack of critical analysis allows an unbroken chain to be constructed between the achievements with wheat and rice in the 1960s and 1970s and the promise of a new Green Revolution in Africa.

As brand hero for the Green Revolution Borlaug helped create and sustain what has become a dominant narrative about the future of agriculture. As always, one aspect of promoting one's brand is trashing the alternatives. Borlaug was an active critic of approaches such as organic farming, put forward by some as alternatives to the Green Revolution. It is fair to say that his high profile, singular focus and forthright speech helped to limit and polarise these debates. Similarly, in aligning himself with the agro-chemical and biotechnology industries in his later years, Borlaug added his voice to those seeking to stifle alternative narratives about the future of agricultural development and close down consideration of alternative pathways.

Finally, it is interesting to reflect on the fact that to date no brand heroes have emerged for the alternative approaches to agricultural development. Why is there no Norman Borlaug equivalent for organic farming or any of the other 'agro-ecological' approaches? To be sure there are some very articulate and high-profile promoters – Tewolde B. G. Egziabher, Miguel Altieri, Jules Pretty and Norman Uphoff to name a few – but none of these individuals can lay claim to either the public profile or the kind of intimate involvement in the development of the brand as Borlaug could through his wheat breeding. The very nature of these agroecological approaches, including their complexity and context specificity, is in stark contrast to the broad environmental adaptation of the semi-dwarf wheat varieties that resulted from Borlaug's innovative 'shuttle breeding'. This complexity and context specificity may well mitigate against the emergence of brand heroes. Closely related to the question of context specificity is the fact that despite a proliferation of 'success stories', to date none of these alternative approaches have yielded the kind of spectacular results seen with the early Green Revolution. In any case, the lack of one or more brand heroes for these approaches puts their advocates at a significant disadvantage in both contested policy processes and more popular arenas.

Notes

1 Later, Borlaug and Dowswell (1995) recognised some of the limitations of this view.

2 On 23 May 2011 a Google search of the string [Borlaug ‘the man who saved a billion’] resulted in 11,900 hits.

3 Borlaug was a primary signatory of the ‘Declaration in Support of Protecting Nature with High-yield Farming and Forestry’

(<http://www.highyieldconservation.org/declaration.html>) which was spearheaded by the Center for Global Food Issues (CGHI), a project of the Hudson Institute which is think tank supported by the agricultural chemical industry

(http://www.sourcewatch.org/index.php?title=Hudson_Institute).

References

- Adesina, A. (2010) A green revolution for africa: Fulfilling the borlaug dream. in, *Borlaug Symposium* (Addis Ababa: Sasakawa Africa Association)
- Angelsen, A. and D. Kaimowitz (2001) Introduction: The role of agricultural technologies in tropical deforestation. in A. Angelsen and D. Kaimowitz eds., *Agricultural technologies and tropical deforestation* (Wallingford: CABI)
- Anonymous (2009) Isaaa celebrates the life of its founding patron, nobel peace laureate. *Crop Biotech Update*, September 18(
- Bagla, P. (2009) A guru of the green revolution reflects on borlaug's legacy. *Science*, 326(5951) p. 361
- Beachy, R. (2010) The borlaug legacy: A new paradigm for agricultural research. in, Bureau of International Information Programs, U.S. Department of State)
- Bellur, V.V., S.P. Singh and R. Chaganti (1990) The white revolution: How amul brought milk to india. *Long Range Planning*, 23(6) pp. 71-79
- Bennett, K.A. (1972) Borlaug on ddt. *BioScience*, 22(6) pp. 337-&
- Bickel, L. (1974) *Facing starvation; norman borlaug and the fight against hunger*, (New York: Dutton)
- Bohannon, J. (2002) Food aid - zambia rejects gm corn on scientists' advice. *Science*, 298(5596) pp. 1153-1154
- Borlaug, N. and C. Dowswell (1995) Mobilising science and technology to get agriculture moving in africa. *Development Policy Review*, 13(2) pp. 115-129
- Borlaug, N.E. (1953) New approach to the breeding of wheat varieties resistant to *puccinia graminis tritici*. *Phytopathology*, 43(9) pp. 467-467
- Borlaug, N.E. (1971a) Ddt, first domino. *Ag Chem and Commerical Fertilizer*, 26(12) pp. 20-&
- Borlaug, N.E. (1971b) Green revolution: For bread and peace. *Bulletin of the Atomic Scientists*, 27(6) pp. 6-9; 47-46
- Borlaug, N.E. (1972a) Mankind and civilization at another crossroad: In balance with nature - a biological myth. *BioScience*, 22(1) pp. 41-44
- Borlaug, N.E. (1972b) Statement on agricultural chemicals. *Clinical Toxicology*, 5(2) pp. 295-&

- Borlaug, N.E. (1974) In defence of ddt and other pesticides. *Pesticides (Bombay)*, 8(5) pp. 14-19
- Borlaug, N.E. (1983) Contributions of conventional plant breeding to crop production. *Science*, 219(4585) pp. 689-693
- Borlaug, N.E. (2002) Feeding a world of 10 billion people: The miracle ahead. *In Vitro Cellular & Developmental Biology-Plant*, 38(2) pp. 221-228
- Borlaug, N.E. (2004a) Foreword. in H. Miller and G. Conko eds., *The frankenfood myth: How protest and politics threaten the biotech revolution* (Westport, CT: Praeger)
- Borlaug, N.E. (2004b) International agricultural research. *Science*, 303(5661) pp. 1137-1138
- Borlaug, N.E. (2007) Feeding a hungry world. *Science*, 318(5849) pp. 359-359
- Borlaug, N.E., I. Narvaez, O. Aresvik and R.G. Anderson (1969) A green revolution yields a golden harvest. *Columbia Journal of World Business*, 4(5) pp. 9-19
- Brinkley, D. (1996) Bringing the green revolution to africa - jimmy carter, norman borlaug, and the global 2000 campaign. *World Policy Journal*, 13(1) pp. 53-62
- Brockington, D. (2008) Powerful environmentalisms: Conservation, celebrity and capitalism. *Media Culture & Society*, 30(4) pp. 551-568
- Brockington, D. (2009) *Celebrity and the environment: Fame, wealth and power in conservation*, Zed Books)
- Byerlee, D. and C.K. Eicher (eds.) (1997) *Africa's emerging maize revolution*, (Boulder, Lynne Rienner Publishers)
- Chissano, J. (2010) Symposium closing comments. . in, *Borlaug Symposium* (Addis Ababa: Sasakawa Africa Association)
- Chong, D. and J.N. Druckman (2007) Framing theory. *Annual Review of Political Science*, 10(pp. 103-126
- Cleaver, H.M., Jr. (1972) The contradictions of the green revolution. *The American Economic Review*, 62(1/2) pp. 177-186
- Conway, G. (1999) *The doubly green revolution: Food for all in the twenty-first century* (Ithaca: Cornell University Press)
- Coull, J.R. (1993) Will a blue revolution follow the green revolution? The modern upsurge of aquaculture. *Area*, 25(4) pp. 350-357
- Daviter, F. (2007) Policy framing in the european union. *Journal of European Public Policy*, 14(4) pp. 654-666
- de Wilde, R. (2000) *De voorspellers: Een kritiek op de toekomstindustrie*, (Amsterdam: De Balie)
- Eagar, T. (2008) Brand hero mythology: The stories generated by a brand community about their brand hero. in D. Spanjaard, S. Denize and N. Sharma eds., *Australia and New Zealand Marketing Academy Conference 2008* (Sydney: Australian and New Zealand Marketing Academy (ANZMAC))
- Eagar, T. (2009) Defining the brand hero: Explorations of the impact of brand hero credibility on a brand community. *Advances in Consumer Research*, 36(pp. 488-493
- Farrington, J. (1995) Mobilising science and technology or fostering organisational change?: A response to borlaug and dowsell. *Development Policy Review*, 13(2) pp. 131-134
- Frankel, F.R. (1971) *India's green revolution: Economic gains and political costs* (Princeton, N.J.: Princeton University Press)
- Gaud, W.S. (1968) Green revolution. *International Development Review*, 10(2) pp. 3- &
- Glover, D. (2010) The corporate shaping of gm crops as a technology for the poor. *Journal of Peasant Studies*, 37(1) pp. 67-90

- Goodman, M. and C. Barnes (2010) *Star/poverty space: The making of the 'development celebrity'*. Working paper 35., (London: Department of Geography, King's College)
- Goodman, M.K. (2010) The mirror of consumption: Celebritization, developmental consumption and the shifting cultural politics of fair trade. *Geoforum*, 41(1) pp. 104-116
- Guillebaud, J. and P. Hayes (2008) Editorial. *BMJ*, 337(a576)
- Hendrix, J.E. (1972) Borlaug on ddt. *BioScience*, 22(5) pp. 274-&
- Herring, R.J. (2007) The genomics revolution and development studies: Science, poverty and politics. *Journal of Development Studies*, 43(1) pp. 1-30
- Hesser, L.F. (2006) *The man who fed the world: Nobel peace prize laureate norman borlaug and his battle to end world hunger* (Dallis: Durban House Publishing Company)
- Iwanaga, M. (2009) Norman ernest borlaug (1914-2009) nobel prize laureate and honorary member of the japanese society of breeding obituary. *Breeding Science*, 59(4) pp. 327-329
- Jansen, K. and A. Gupta (2009) Anticipating the future: 'biotechnology for the poor' as unrealized promise? . *Futures*, 41 (7) pp. 436-445.
- Kay, M.J. (2006) Strong brands and corporate brands. *European Journal of Marketing*, 40(7-8) pp. 742-760
- Keeley, J. and I. Scoones (2003) *Understanding environmental policy processes: Cases from africa*, (London & Sterling, VA: Earthscan)
- Keller, K.L. and D.R. Lehmann (2006) Brands and branding: Research findings and future priorities. *Marketing Science*, 25(6) pp. 740-759
- Khush, G.S. (2009) Norman borlaug 1914-2009 obituary. *Food Security*, 1(4) pp. 389-390
- Krebs, C.T. (1972) Borlaug on ddt. *BioScience*, 22(5) pp. 274-&
- Ladejinsky, W. (1970) Ironies of india's green revolution. *Foreign Affairs*, 48(4) pp. 758-768
- Leach, M., I. Scoones and I. Stirling (2010) *Dynamic sustainabilities: Technology, environment, social justice*, (London: Earthscan)
- Lipton, M. (2007) Plant breeding and poverty: Can transgenic seeds replicate the 'green revolution' as a source of gains for the poor?'. *Journal of Development Studies*, 43(1) pp. 31-62
- McAlexander, J.H., J.W. Schouten and H.F. Koenig (2002) Building brand community. *Journal of Marketing*, 66(1) pp. 38-54
- McCracken, G. (1989) Who is the celebrity endorser? Cultural foundations of the endorsement process. *Journal of Consumer Research*, 16(pp. 310-321
- McGovern, G. (2010) "He did his damndest to feed the world" norman borlaug was an american original who saved more lives anyone than else in history. *American History*, 44(6) pp. 64-65
- Miller, H. and G. Conko (eds.) (2004) *The frankenfood myth: How protest and politics threaten the biotech revolution*, (Westport, CT, Praeger)
- Muniz, A.M.J. and T.C. O'Guinn (2001) Brand community. *Journal of Consumer Research*, 27(pp. 412-432
- Mwale, P.N. (2006) Societal deliberation on genetically modified maize in southern africa: The debateness and publicness of the zambian national consultation on genetically modified maize food aid in 2002. *Public Understanding of Science*, 15(1) pp. 89-102
- Ortiz, R., D. Mowbray, C. Dowswell and S. Rajaram (2007) Dedication: Norman e. Borlaug, the humanitarian plant scientist who changed the world. *Plant Breeding Reviews*, 28(pp. 1-38

- Paddock, W.C. (1970) How green is the green revolution? *BioScience*, 20(16) pp. 897-902
- Palagyi, A. (2009) Farewell to professor normal ernest borlaug, obituary. *Cereal Research Communications*, 37(4) pp. 629-630
- Parthasarathy, G. (1991) White revolution, dairy cooperatives and weaker sections. *Economic and Political Weekly*, 26(52) pp. A177-A183
- Peakall, D.B. (1972) Borlaug on ddt. *BioScience*, 22(7) pp. 393-&
- Pearce, F. (2011) Will intensified farming save the rainforests? *New Scientist*, 2798) pp. 26-27
- Philogen, B.J. (1972) Borlaug on ddt. *BioScience*, 22(7) pp. 393-&
- Quinn, K.M. (2008) Dr. Norman e. Borlaug: Twentieth century lessons for the twenty-first century. Pp. 1-13 in, *Advances in agronomy*
- Rajaram, S. (2011) Norman borlaug: The man i worked with and knew. *Annual Review of Phytopathology*, 49(pp. 3.2 - 3.14
- Richey, L.A. and S. Ponte (2011) *Brand aid: Shopping well to save the world*, (Minneapolis: University of Minnesota Press)
- Robinson, B. (1972) Bolraug on ddt. *BioScience*, 22(5) p. 273
- Roe, E.M. (1991) Development narratives, or making the best of blueprint development. *World Development*, 19(4) pp. 287-300
- Scoones, I. (2006) *Science, agriculture and the politics of policy: The case of biotechnology in india*, Orient Longman)
- Stokburger-Sauer, N. (2010) Brand community: Drivers and outcomes. *Psychology & Marketing*, 27(4) pp. 347-368
- Swaminathan, M.S. (2004) Ever-green revolution and sustainable food security. in A. Eaglesham, A. Wildeman and R. W. F. Hardy eds., *Agricultural biotechnology: Finding common international goals* (Ithaca: National Agricultural Biotechnology Council)
- Swaminathan, M.S. (2009) Norman e. Borlaug (1914-2009) obituary. *Nature*, 461(7266) pp. 894-894
- Swanson, L. (2009) *Norman borlaug: Hero in a hurry*, Booksurge)
- Tomar, S.M.S. (2009) Norman e. Borlaug, the father of green revolution who saved millions from starvation (march 25, 1914-sept. 12, 2009) obituary. *Indian Journal of Genetics and Plant Breeding*, 69(4) pp. 403-403
- Tuns, P. (2009) Borlaug proved malthus wrong. in, *The Interim: Canada's Life and Family Newspaper*)
- Vietmeyer, N. (2009a) *Borlaug, volume 1, right off the farm, 1914 – 1944* (Lorton, Virginia: Bracing Books)
- Vietmeyer, N. (2009b) *Borlaug, volume 2, wheat whisperer, 1944 – 1959*, (Lorton, Virginia: Bracing Books)
- Vietmeyer, N. (2009c) *Borlaug, volume 3, bread winner, 1960-1969*, (Lorton, Virginia: Bracing Books)
- Vietmeyer, N. (2011) *Our daily bread, the essential norman borlaug* (Lorton, Virginia: Bracing Books)
- Weiss, J.A. (1989) The powers of problem definition: The case of government paperwork. *Policy Sciences*, 22(2) pp. 97-121